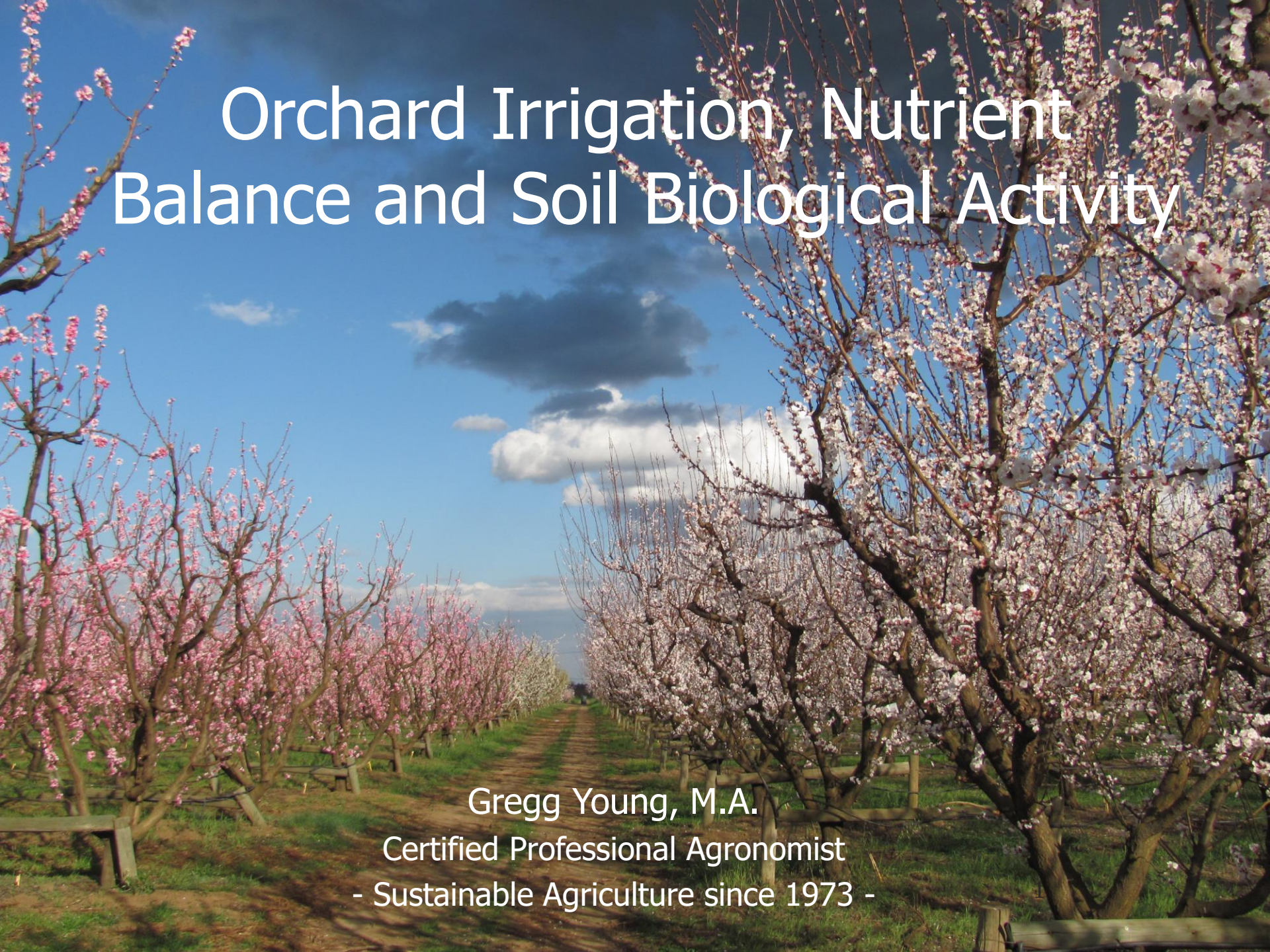


Orchard Irrigation, Nutrient Balance and Soil Biological Activity

Gregg Young, M.A.
Certified Professional Agronomist
- Sustainable Agriculture since 1973 -

The Soil Management Program:

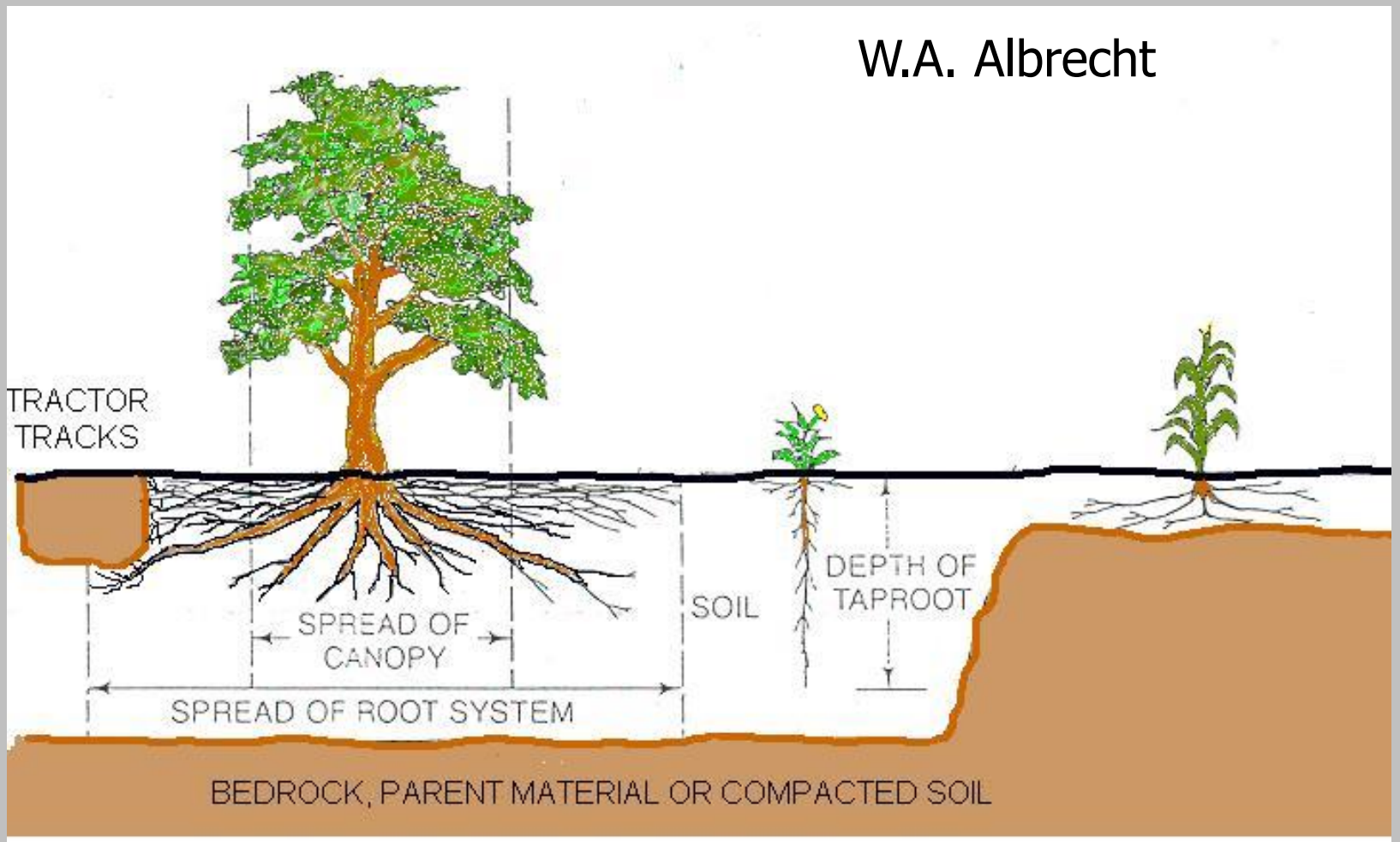
- Balance soil exchangeable cations to 65-75% Ca; 10-15% Mg; 2-5% K; 0-5% Na (as % of total cation exchange capacity; maintaining cation balance with appropriate mineral amendments.
- Maintain P, K, S and micronutrients at generous levels
- Build and maintain OM through cover cropping, addition of composted organic matter and/or microbial soil inoculants, and promotion of healthy biological activity in soil
- Supply N in adequate amounts (for crop needs only) avoiding excess soluble N, applying N sparingly in split applications or via composted OM for activation of N cycle and slow release
- Foliar feeding of nutrients known to be deficient; applying during stressful times (bloom, maturity, adverse weather, pest/disease pressure, etc (Young, 1988)

Adjustments for FHF:

- Due to the high removal of K we keep it close to 5% of exchangeable cations
- Low removal of P by tree fruits and high availability from OM; only compost used for this
- High priority = fungal dominated compost & inoculants used
- Some areas need additional soluble N; individual block or spot treatment is best
- Lots of Ca and K foliar sprays due to high removal

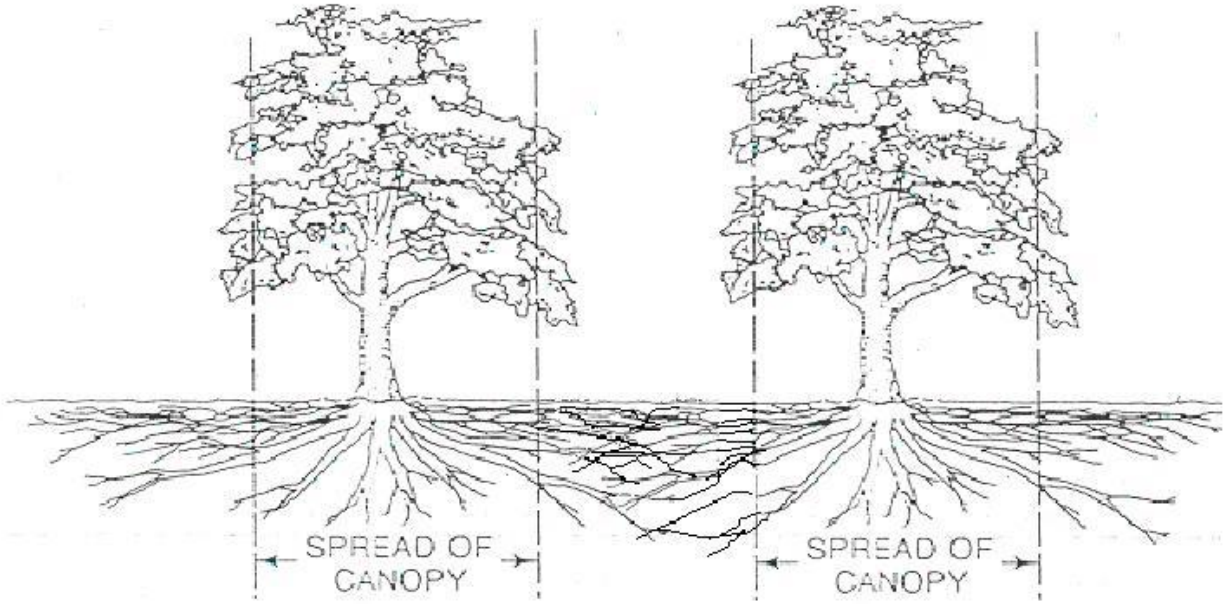
"Food is fabricated fertility"

W.A. Albrecht



Plant roots spread far from the plant seeking water and nutrients. Most roots spread laterally near the soil surface where the oxygen and carbon dioxide content is highest. Most of the biological activity and nutrient availability is at or just beneath the top foot of soil. Conditions that limit the spread of roots, like soil compaction, impervious layers, or saturated soil, also limit plant growth, yield, and health.

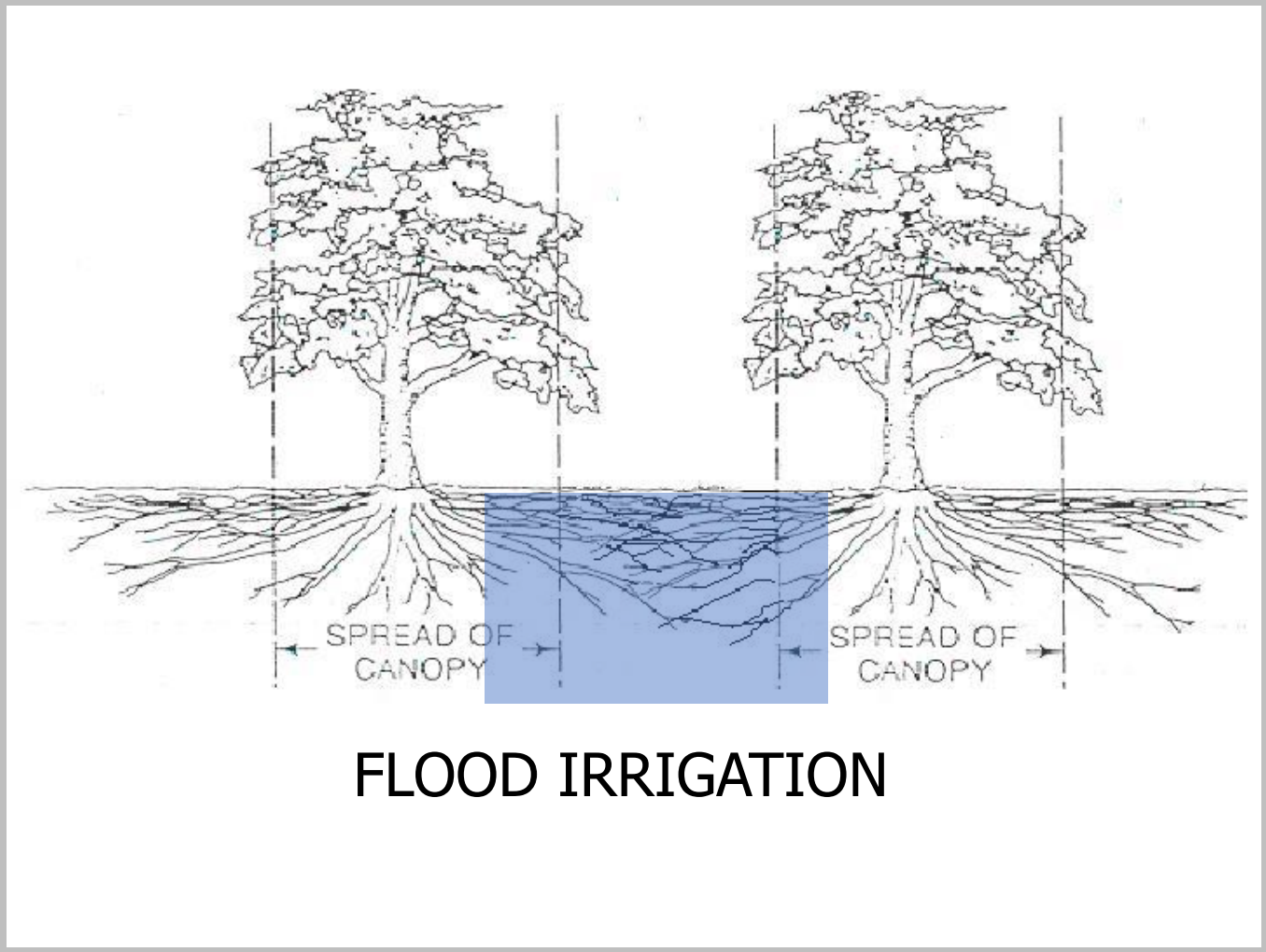
Modern Agriculture Squeezes the Most out of the Agroecosystem



Pears, Apples: 20 tons/ac
Grapes: 5-12 tons/ac

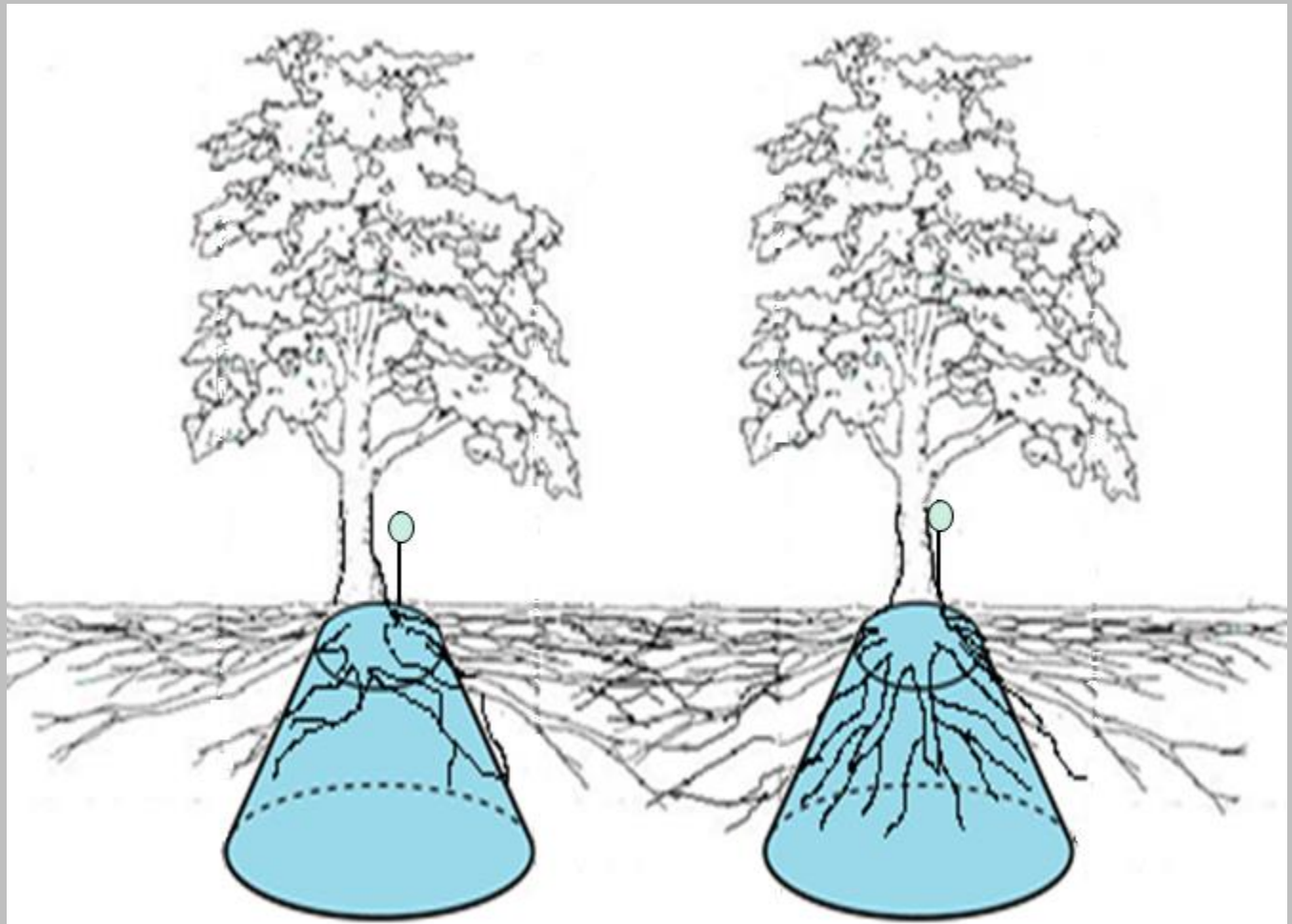
Tomatoes: 40 tons/ac
Hay crops: 20 tons/ac

Roots of healthy trees under irrigation will be competing with each other



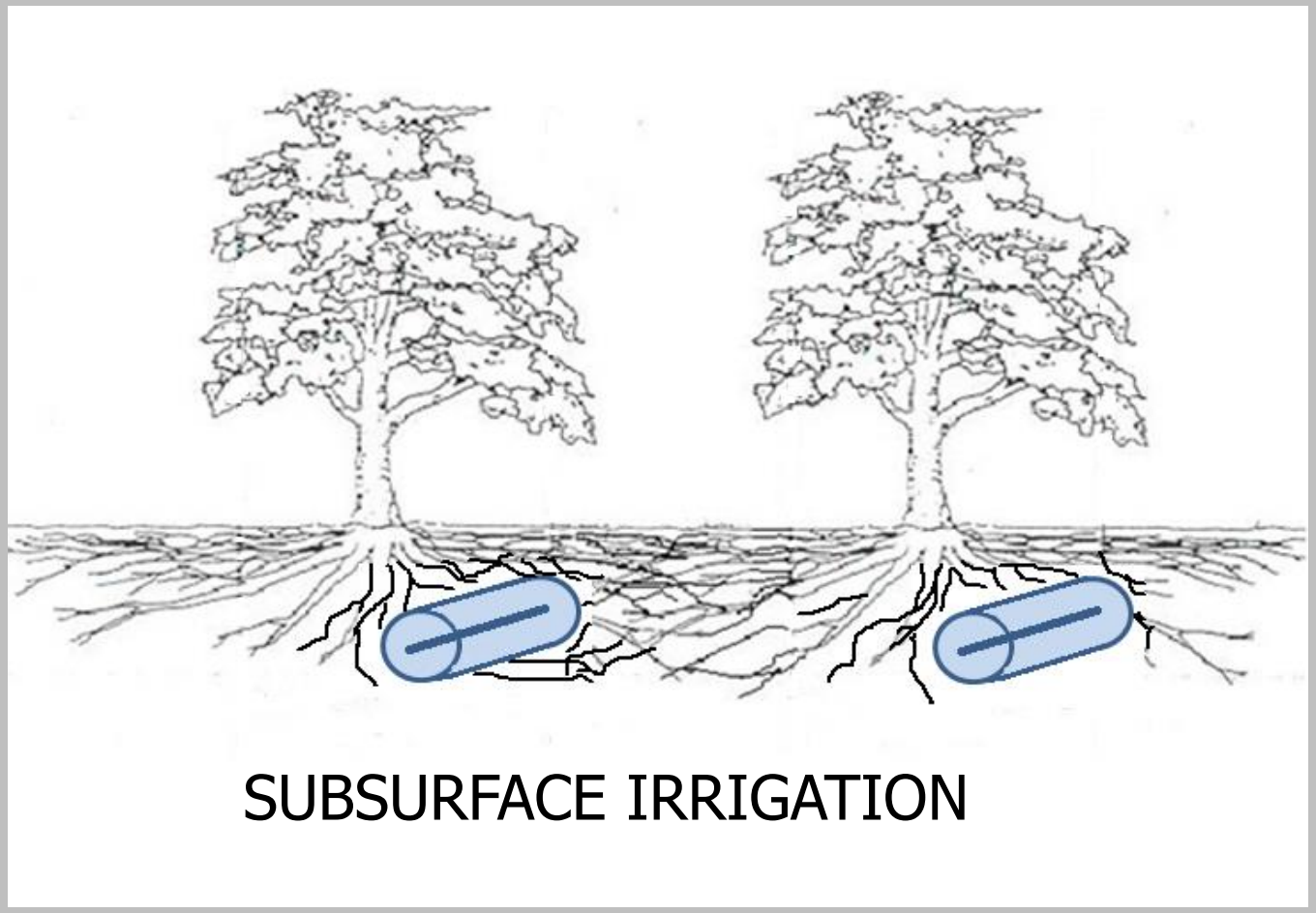
FLOOD IRRIGATION

Orchard irrigation emitters cover 1/3 to 1/2 of the orchard floor



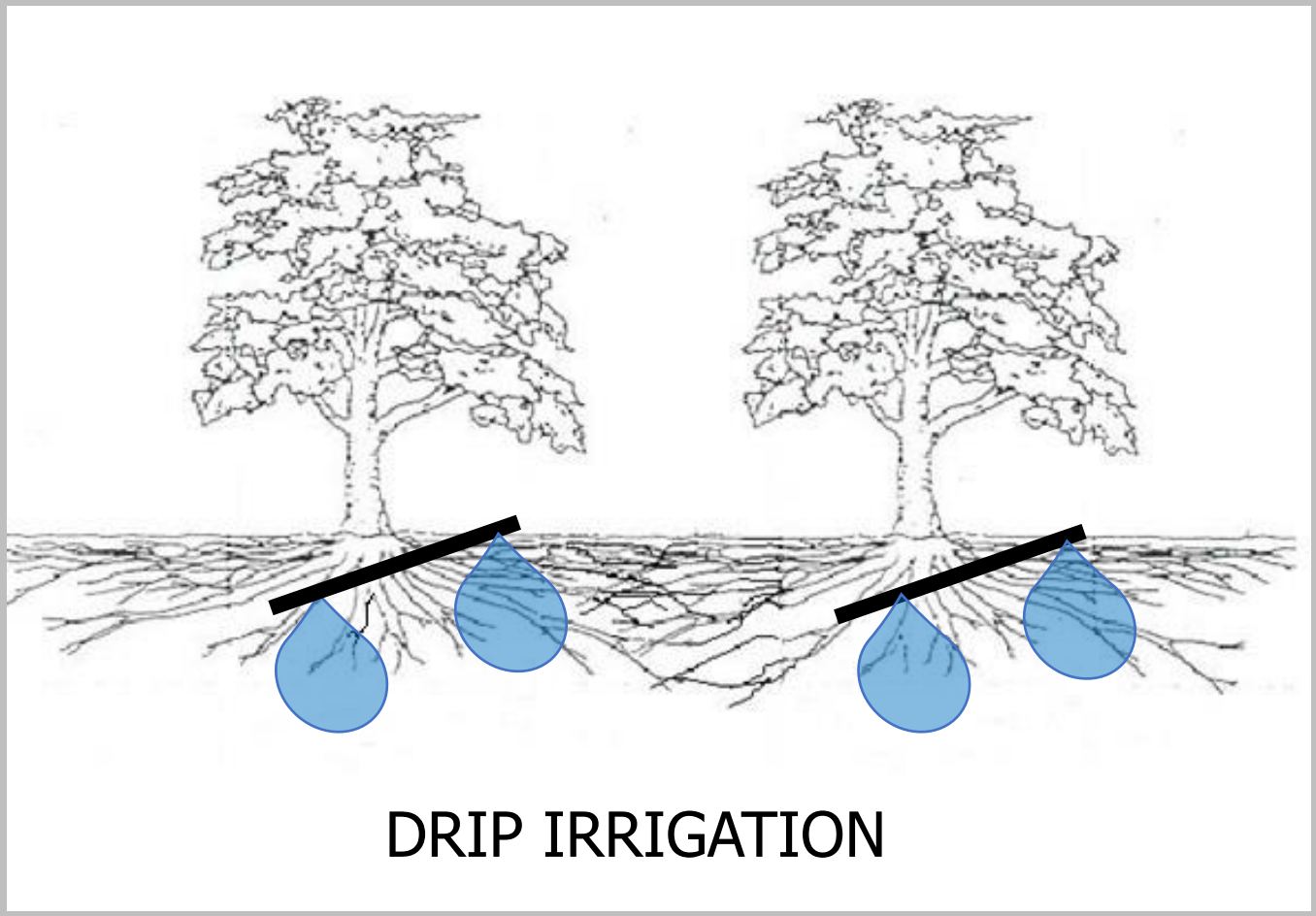
MISTER IRRIGATION

Under subsurface drip irrigation there will be small, long cylinders within the root zone but below the active humus layer



SUBSURFACE IRRIGATION

Drip irrigation provides much less wetted area



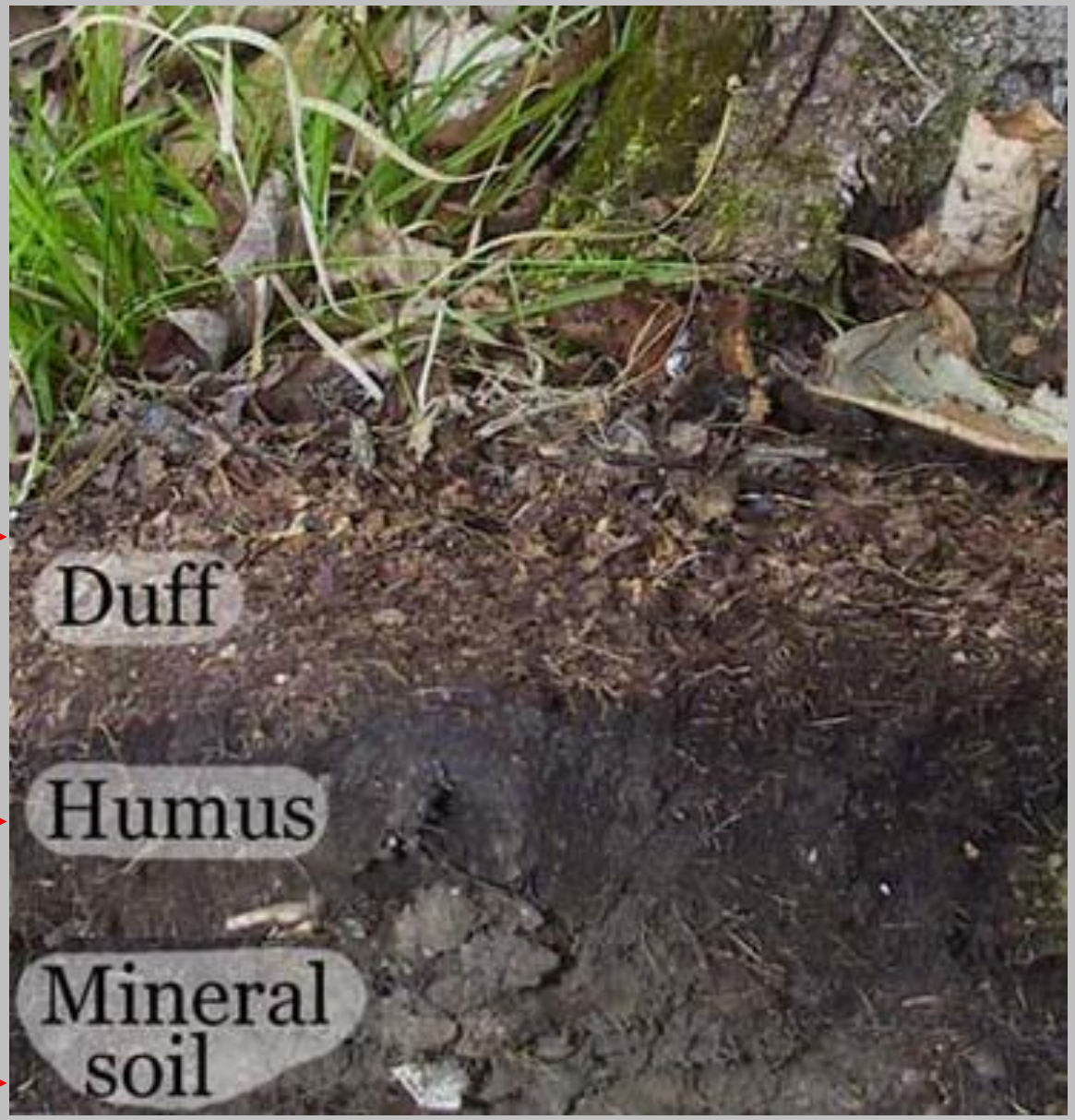
DRIP IRRIGATION

SOIL ORGANIC MATTER

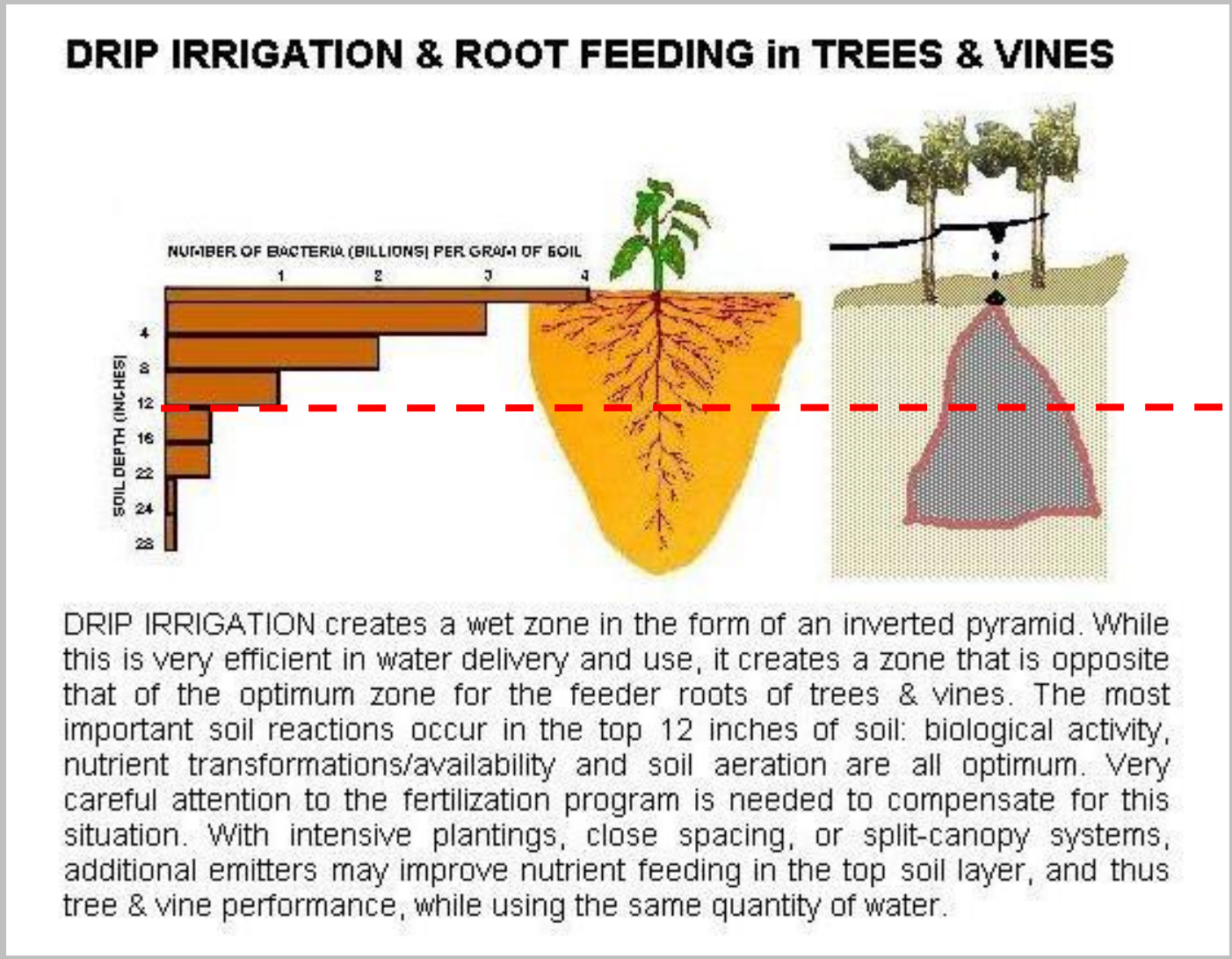
Raw organic matter; not counted in soil analysis. Must decompose to release nutrients & other compounds. Forests have fungi > bacteria & other life

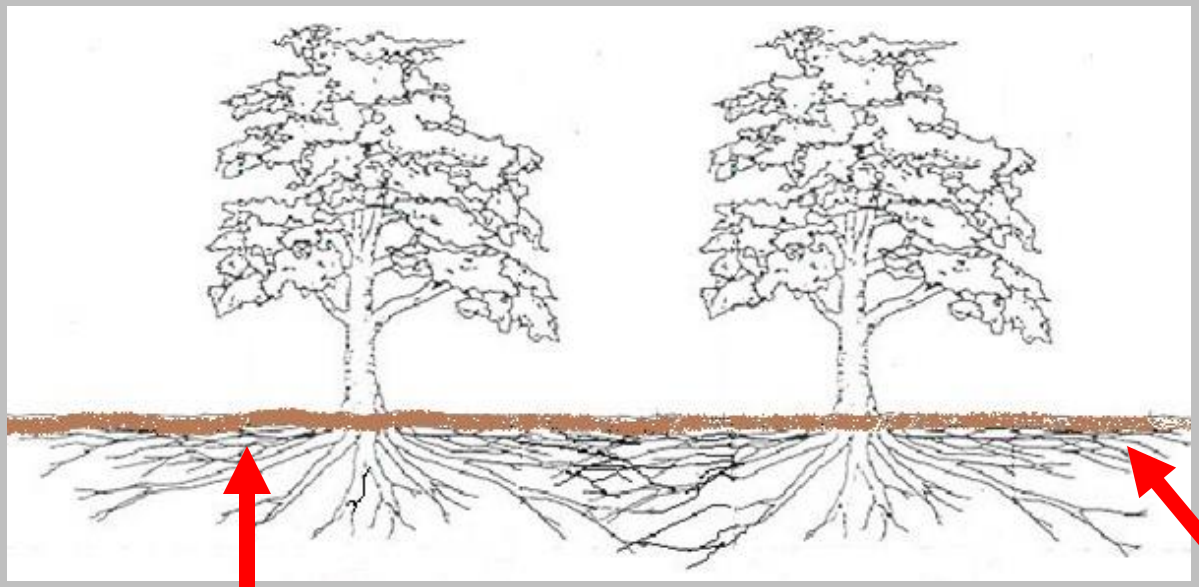
Active humus is where nutrients are cycled; stable humus mostly minerals & humic acids

Minerals are the source of most nutrients except carbon, oxygen & nitrogen (which come from the air)

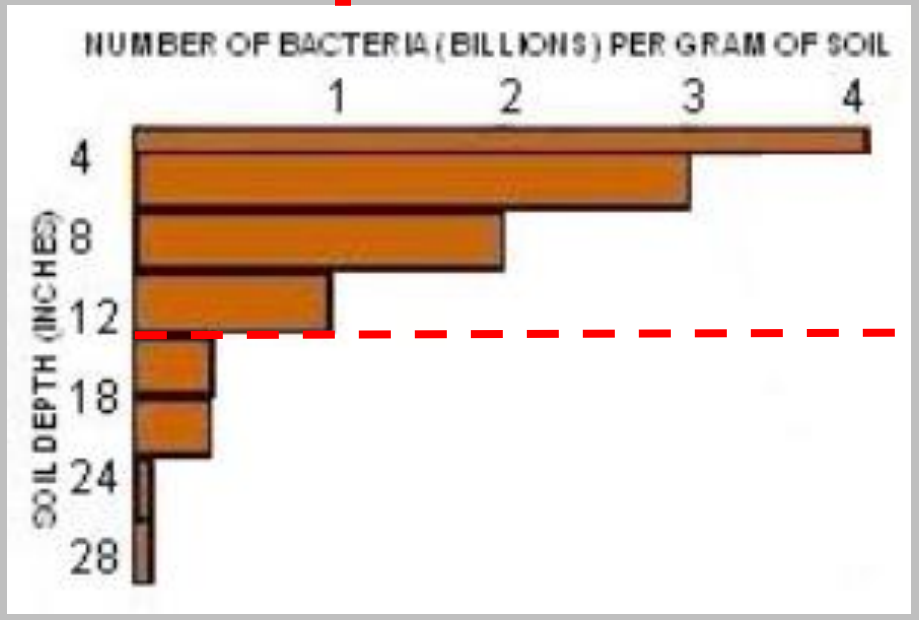


Drip irrigation – nutrient removal is from a smaller area; nutrient management is critical

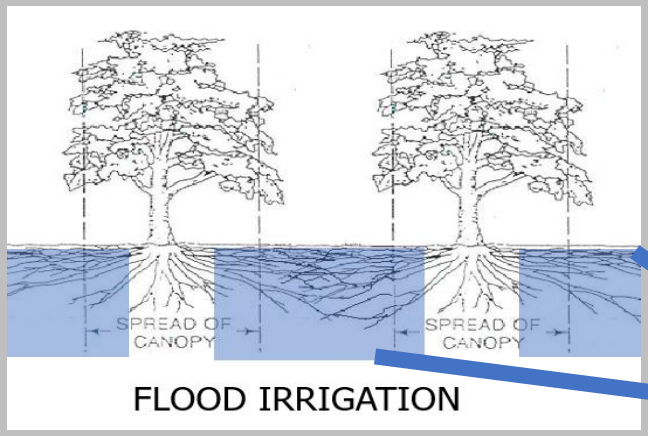




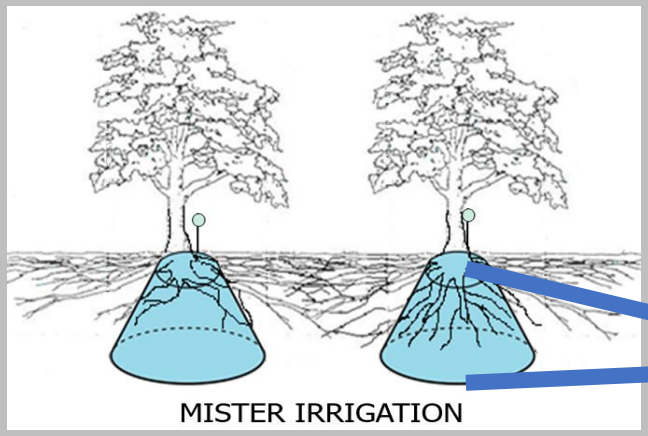
What is going on in the top 12” of soil?

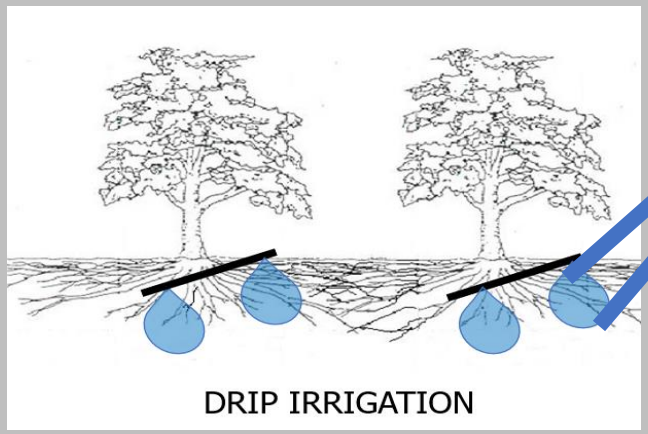


BIOMASS of ORGANISMS per acre in a PASTURE	
Organism	# fresh weight
Fungi	3600
Bacteria	2700
Worms	1200
Protozoa	340
Algae	180
Nematodes	100
Total Microorganisms = 8100 #	



FLOOD IRRIGATION

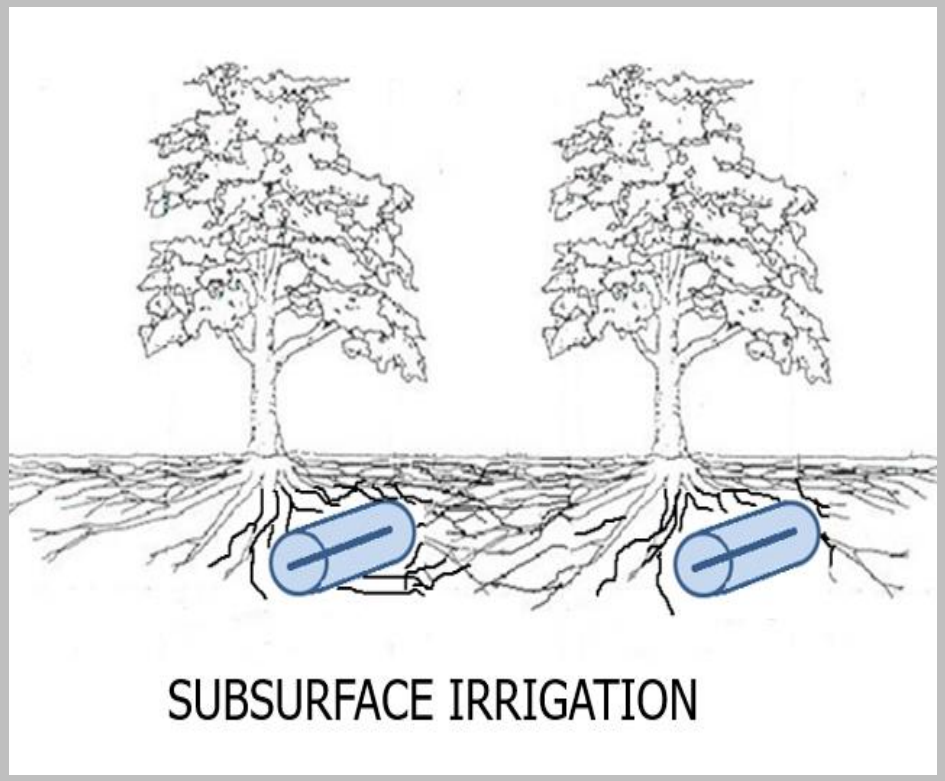

MISTER IRRIGATION


DRIP IRRIGATION

AVERAGE ANNUAL NUTRIENT REMOVAL – POME & STONE FRUIT

K	155 #
N	122 #
Ca	104 #
Mg	27 #
P	17 #
Pounds/ac	

EACH REDUCTION IN WETTED AREA MEANS THESE NUTRIENTS HAVE TO COME FROM SMALLER VOLUMES

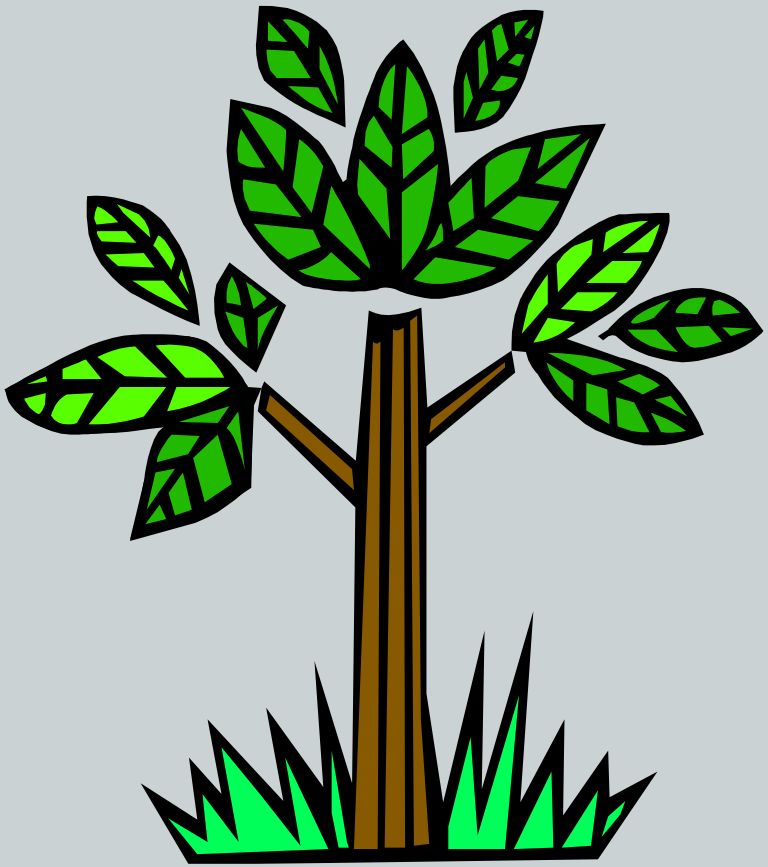


How do we make sub-surface irrigation work?

DISADVANTAGES:

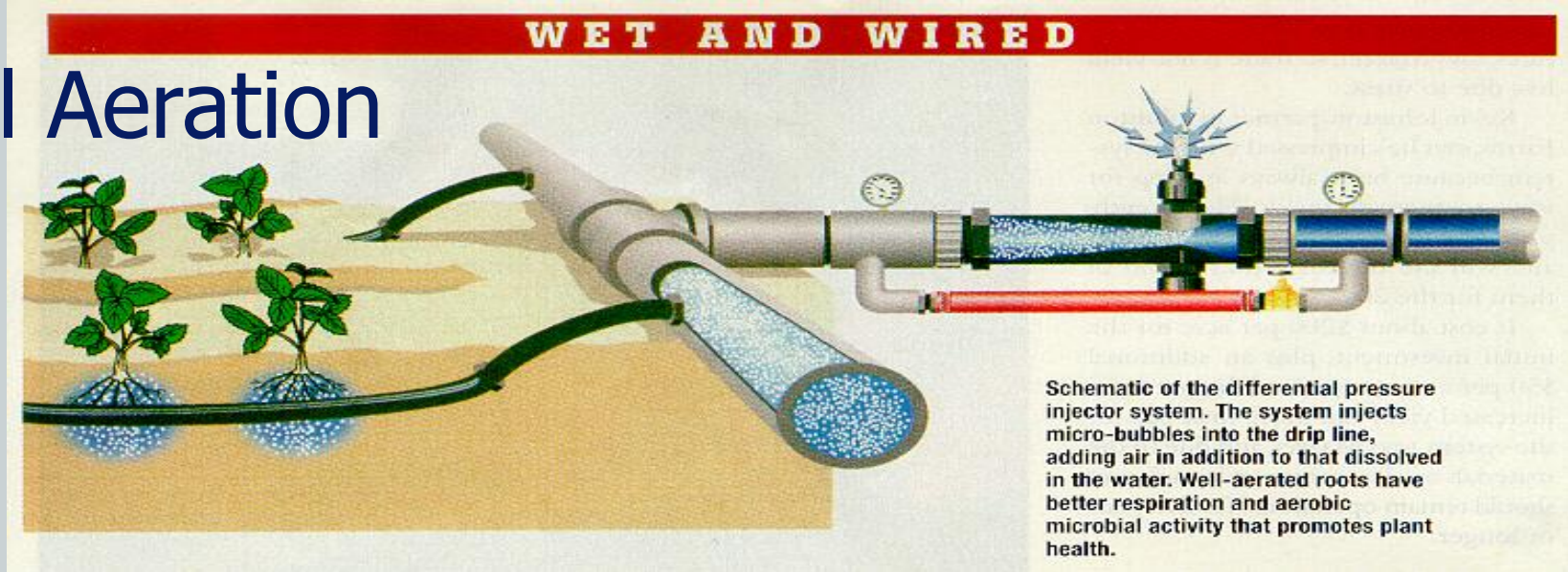
- NO LEACHING OF NUTRIENTS FROM ABOVE
- DRY OM/HUMUS AREA
- PRECISE SOLUBLE NUTRIENT LEVELS NEEDED
- LOWER AIR CONTENT FOR BIOLOGICAL PROCESSES
- CLOSER TO GROUNDWATER = INCREASED NUTRIENT LEACHING?

Soil Aeration



- Plants need O_2 & CO_2 in the root zone
- Organic matter needs air to break down
- Nutrients are available in the oxidized form: Examples: P_2O_5, NO_2, SO_4
- Root zone goes anaerobic during rain or irrigation
- Plants differ in their ability to grow under low air conditions - few crops enjoy it

Soil Aeration



- Yield increases of 10-30%
- Healthier growing environment
- Increased root mass
- Lower plant stress level
- Increased soil microbial activity

California Farmer V284(7) April 2001

Making sub-surface irrigation work:

- Soluble fertilizer injection?
  - Difficult with organics; easy with chemicals
  - Clogging of system? Can inject system cleaners (citric acid, vinegar)
- Air injection
  - Mazzei injectors relatively simple, no power needed
- Inoculation from surface or sub?
  - Compost or tea applied to surface will be working part of the year (rainy season)
  - Injection will help; clogging possible; cleaners might impact beneficial organisms
- Other methods?